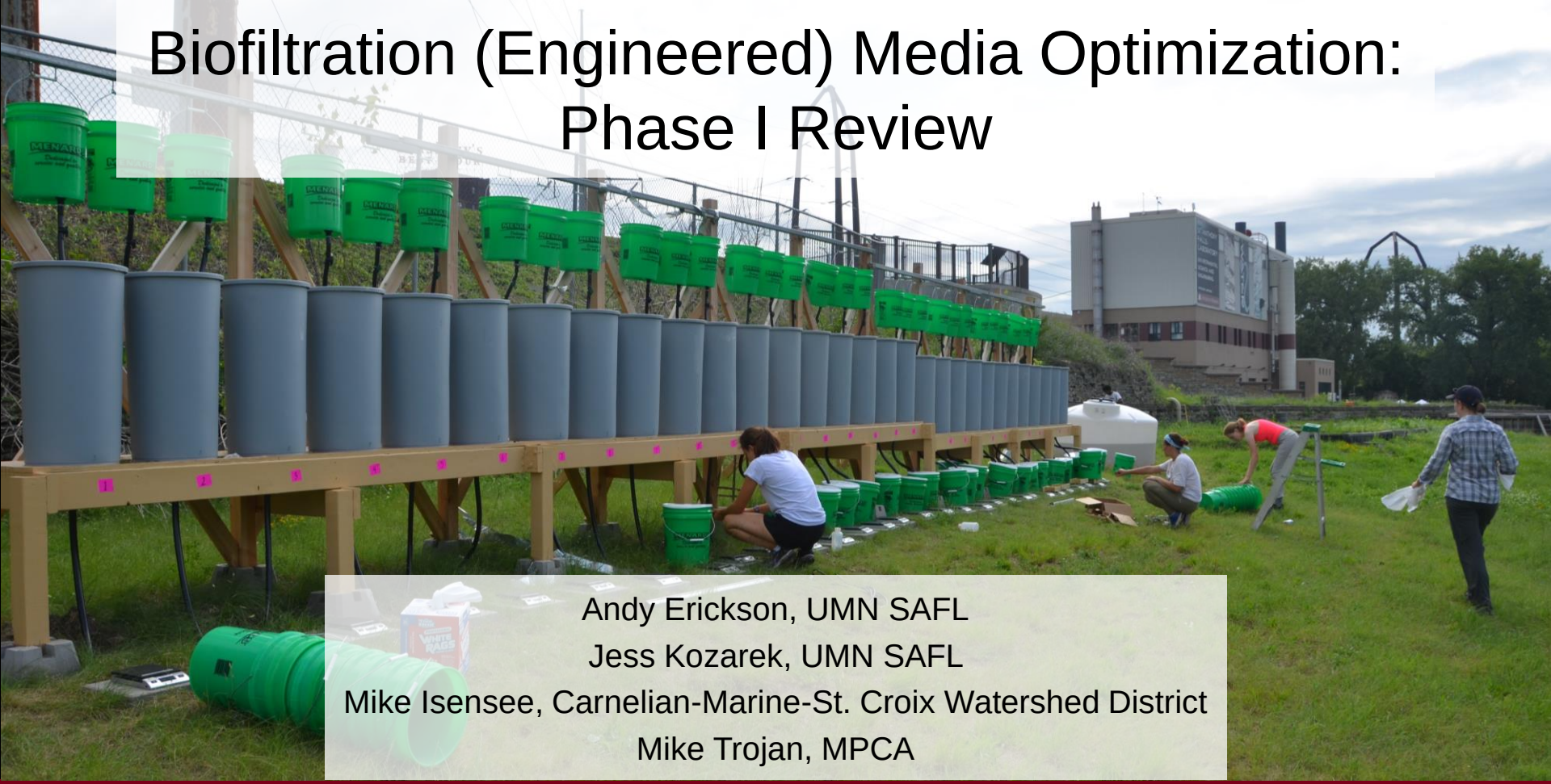
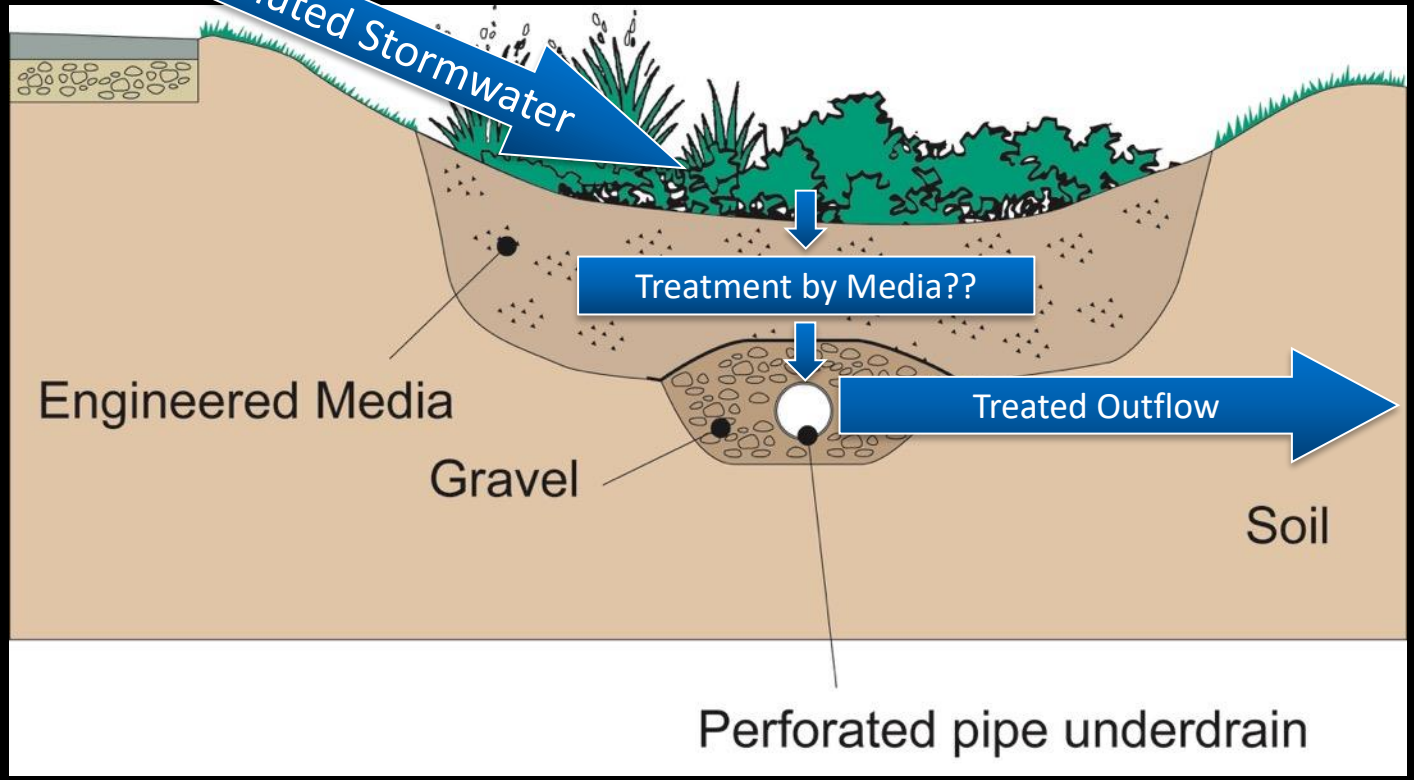
Biofiltration (Engineered) Media Optimization: Phase I Review



Andy Erickson, UMN SAFL
Jess Kozarek, UMN SAFL
Mike Isensee, Carnelian-Marine-St. Croix Watershed District
Mike Trojan, MPCA

What is Biofiltration???



Processes:

- Filtration
- Vegetation
- Soil Microbes

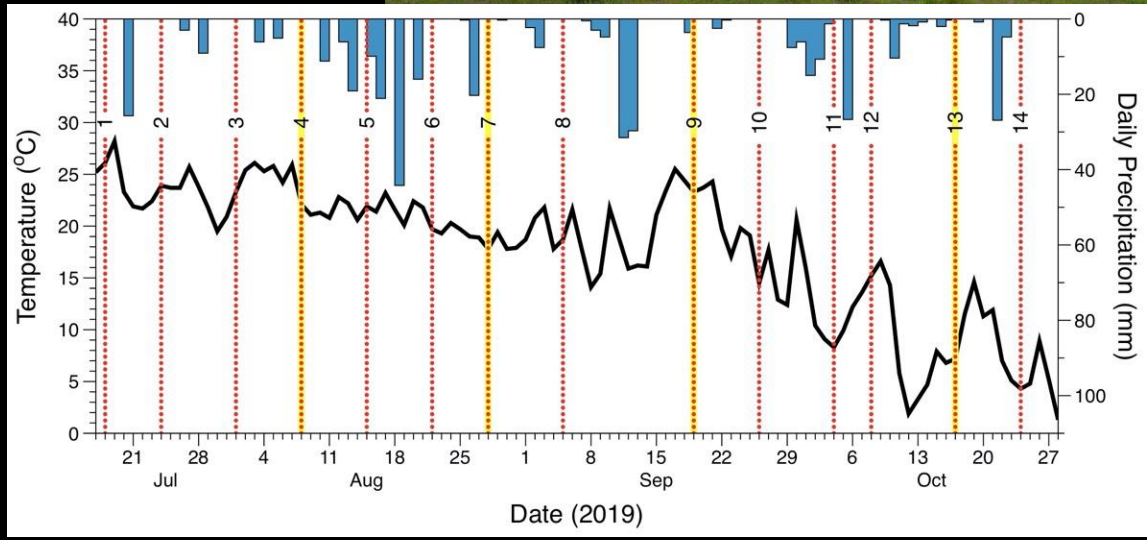
Challenges?

- P Release
- Slow Filtration
- Poor Vegetation

Mesocosm Experiments

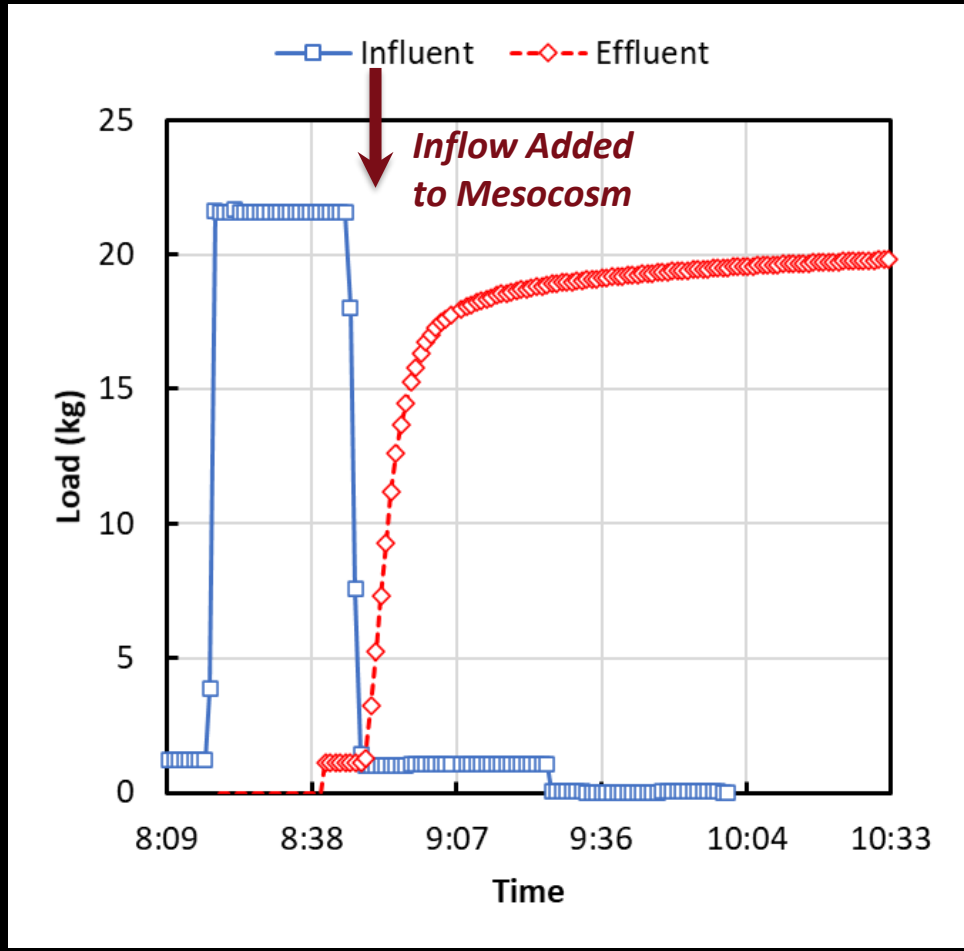
14 simulated events in 2019 + 8 events in 2020 thru Thirty Mesocosms:

- 100% Clean Washed Sand
- 10% food residue compost
- 20% food residue compost
- 10% leaf compost
- 20% leaf compost
- 20% sphagnum peat
- 20% reed sedge peat
- 15% biochar + 20% leaf
- 5% spent lime + 20% leaf
- 5% iron + 20% leaf

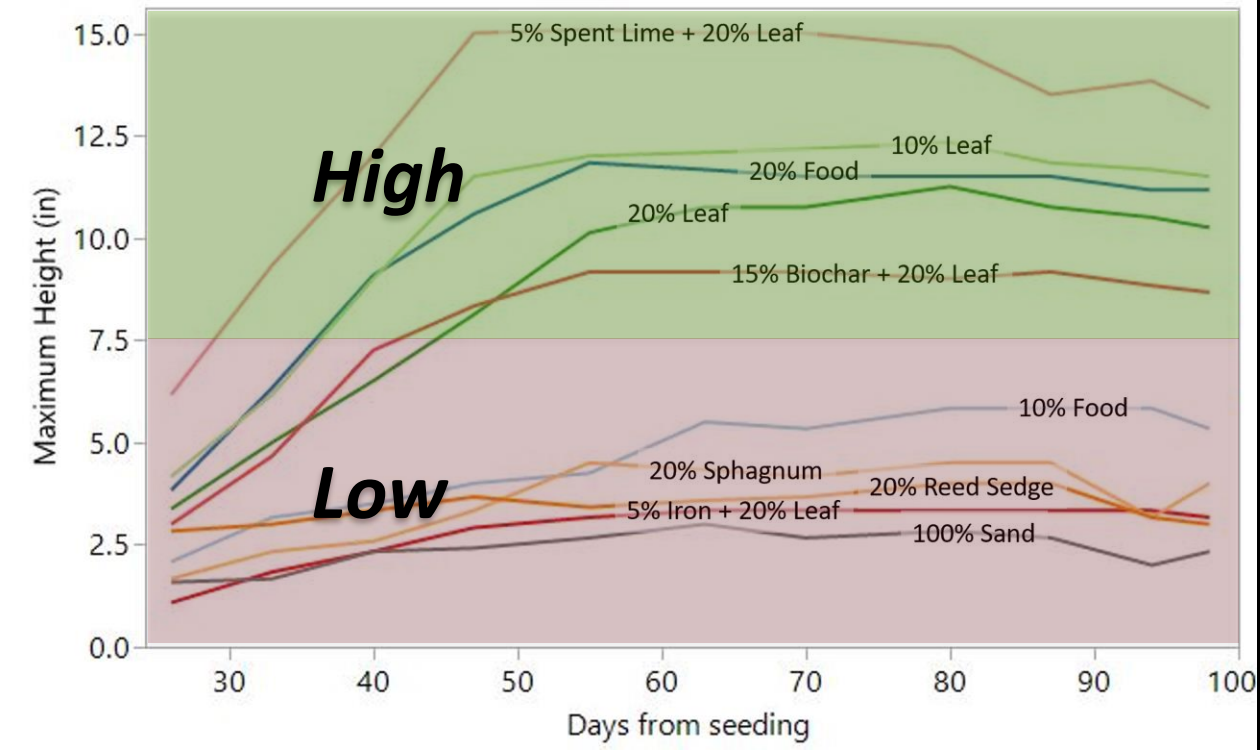


Objective 1: Filtration Rate

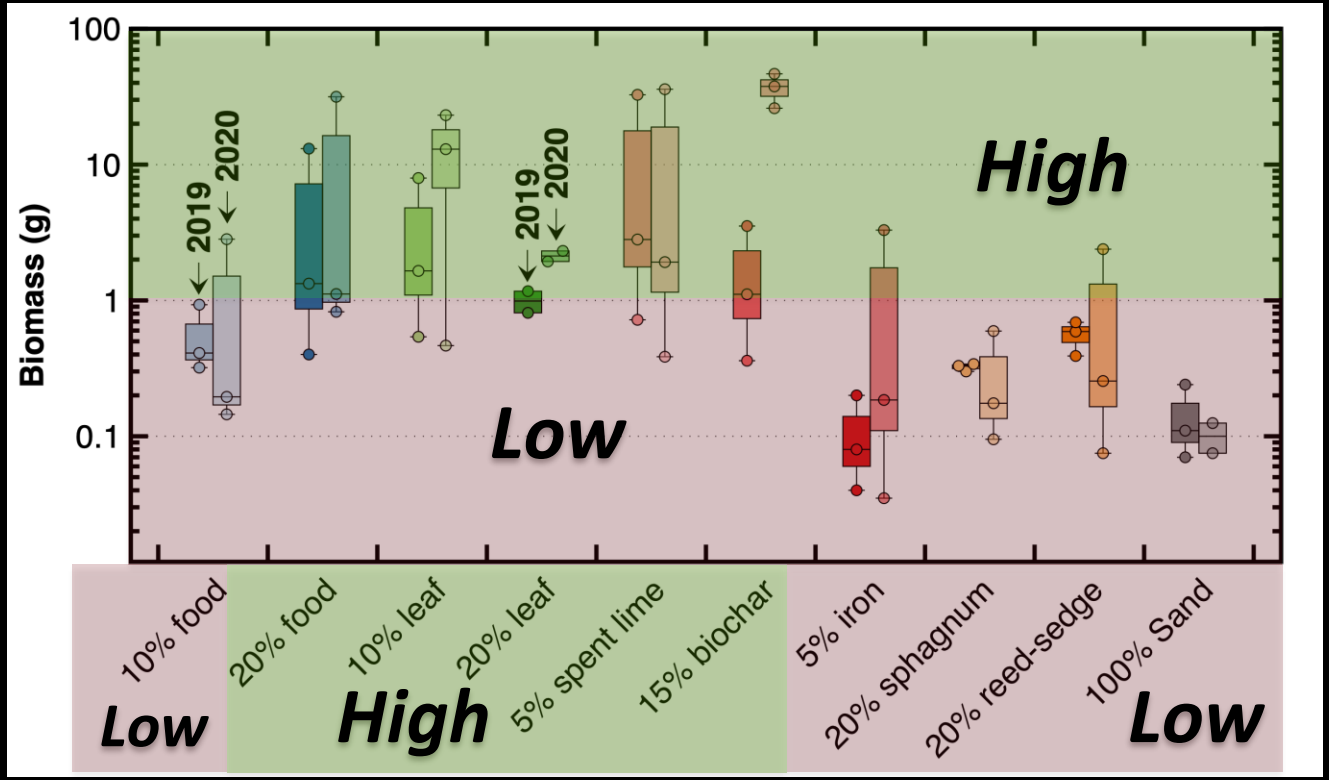
- 50% volume within ~ 5 – 15 min
- 70-80% volume within ~ 20 min
- Most mixes have similar flow characteristics



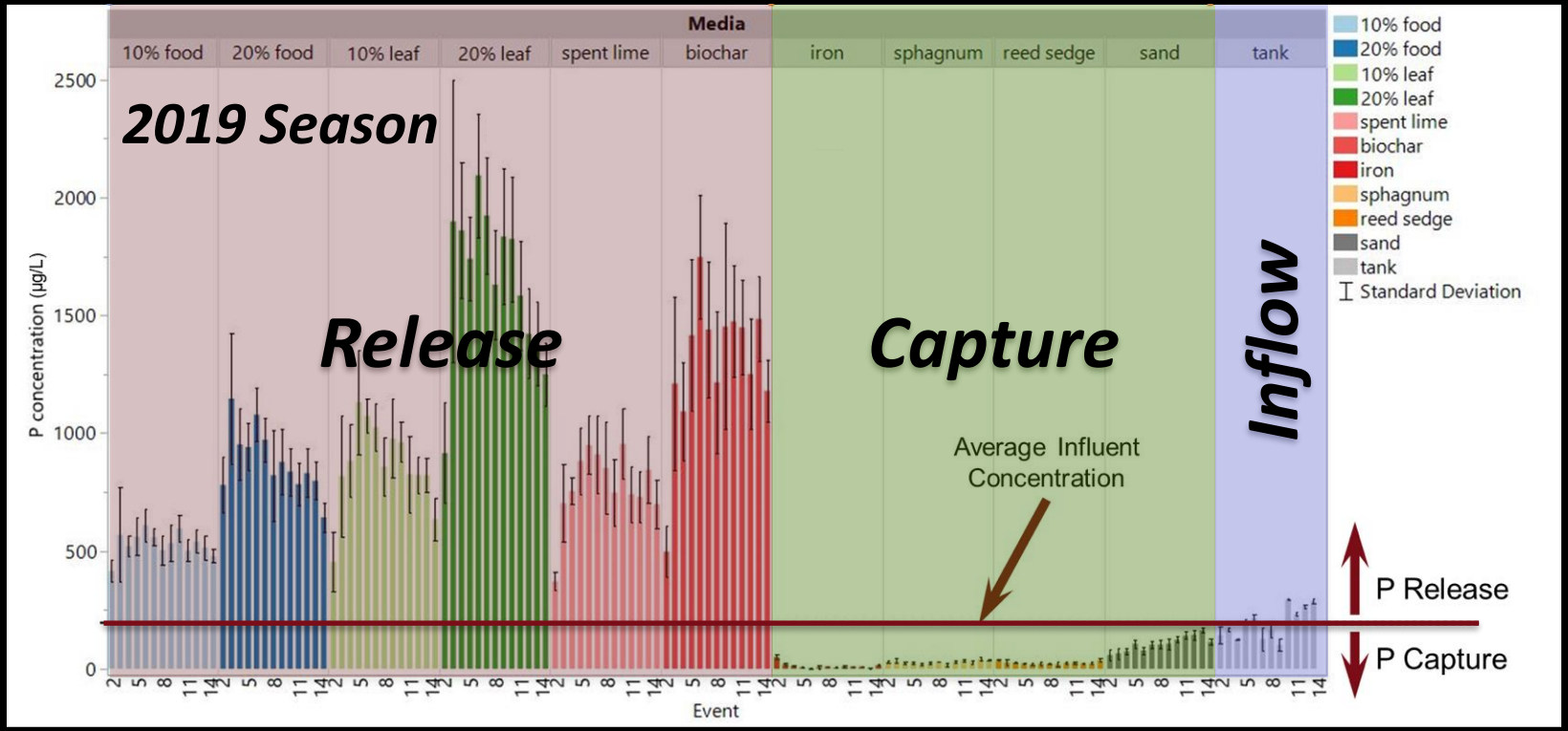
Objective #2: Supporting Vegetation Growth



Objective #2: Supporting Vegetation Growth



Objective #3: Limiting Phosphate Release



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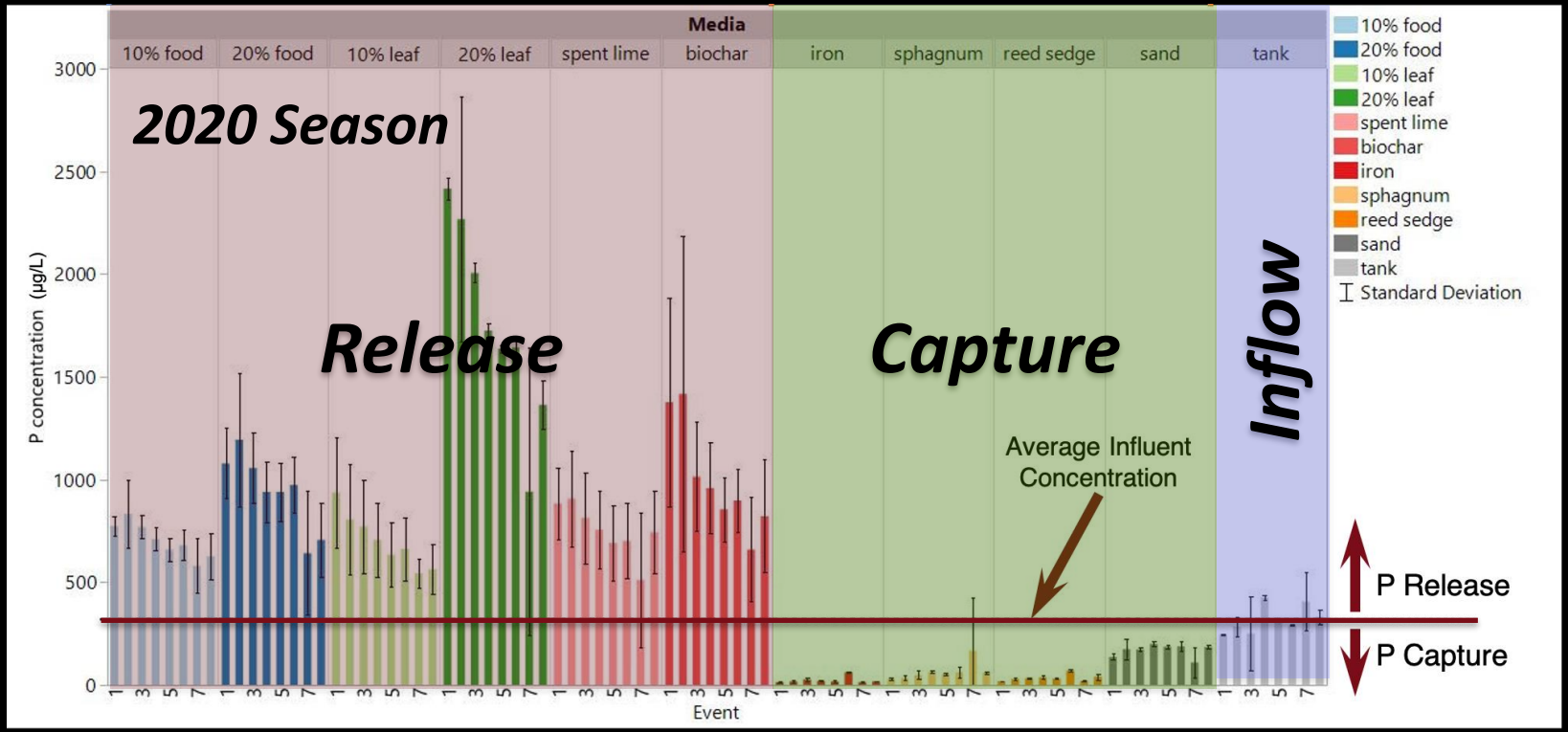

Key Takeaways

Media	Filtration Rate	Vegetation Growth	Phosphate Capture
10% or 20% Leaf Compost	Same	More	Release
10% or 20% Food Residue Compost	Same	More	Release
5% Spent Lime + 20% Leaf Compost	Same	***Most***	Release
15% Biochar + 20% Leaf Compost	Same	More	Release
5% Iron + 20% Leaf Compost	Slightly Faster	***Least***	Capture
20% Peat (Sphagnum or Reed Sedge)	Same	Less	Capture
100% Sand	Same	***Least***	Minimal Capture

Full Report: *Erickson, Andrew J.; Kozarek, Jessica L.; Kramarczuk, Kathryn A.; Lewis, Laura. (2021). Biofiltration Media Optimization – Phase I Final Report. Retrieved from the University of Minnesota Digital Conservancy, https://hdl.handle.net/11299/218193*

Phase II Expansion
(May 2020– December 2022)

- Evaluate the multi-year performance (extending Phase I)
- Add new mixes: Layered systems, different media ratios, etc.
- Investigate the phosphate release in response to road salt
- Test plant growth in low-organic content (1% – 10%) mixes
  - 10 vegetation species and 5 – 15 media mixes

Phase I Project Team

- **Andy Erickson (PI), UMN SAFL, eric0706@umn.edu**
- **Jess Kozarek (Co-Lead), UMN SAFL**
- **Laura Lewis, UMN SAFL**
- **Katie Kramarczuk, UMN SAFL**
- Barbara Heitkamp, UMN SAFL
- John Chapman, UMN, BBE
- Mike Isensee (Co-Lead), Carnelian-Marine-St. Croix Watershed District
- Mike Trojan, MPCA
- David Fairbairn, MPCA
- Erin Anderson Wenz, Barr Engineering

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- For more information about the Center and the Council, visit https://www.wrc.umn.edu/projects/storm-waste-water
- For more information about the Minnesota Clean Water, Land and Legacy Amendment, visit https://www.legacy.mn.gov/about-funds

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Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the Water Resources Center or Minnesota Stormwater Research Council.

CLEAN WATER LAND & LEGACY AMENDMENT

Acknowledgements

- The authors wish the thank the University of Minnesota Water Resources Center, the Minnesota Stormwater Research Council, affiliated entities for provided funding to support this project. Support and assistance from several organizations and individuals are listed below and is greatly appreciated. Support and assistance for the contracting process was provided by John Bilotta, Kari Lamp, and Jenni Larson.
- The authors also wish to thank several individuals that provided input during a listening session (February 1, 2019) and the Technical Advisory Team meeting (February 8, 2021) and/or throughout the project.
- The authors wish to thank the following organizations for providing materials for the experiments:
  - Plaisted Companies (Elk River, MN)
  - Creekside Soils (Hutchinson MN),
  - Empire Mulch (Rosemount MN),
  - Cologne Compost (Cologne MN),
  - Cottage Grove Compost (Cottage Grove MN)
  - Shakopee Mdewakanton Sioux Community (SMSC) Organics (Shakopee MN)
- Support provided by St. Anthony Falls Laboratory (SAFL) staff and students include Aaron Ketchmark, Alyson Skoglund, Anna Healy, Ben Erickson, Jack Lorentzen, Katie Kemmitt, Melissa Friese, Nam Nguyen, Tasha Spencer, Sam Hirsch, Sam Wang, and Yiling Chen.

Thanks for your attention!

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Laura Lewis

Engineering Media w/ Compost

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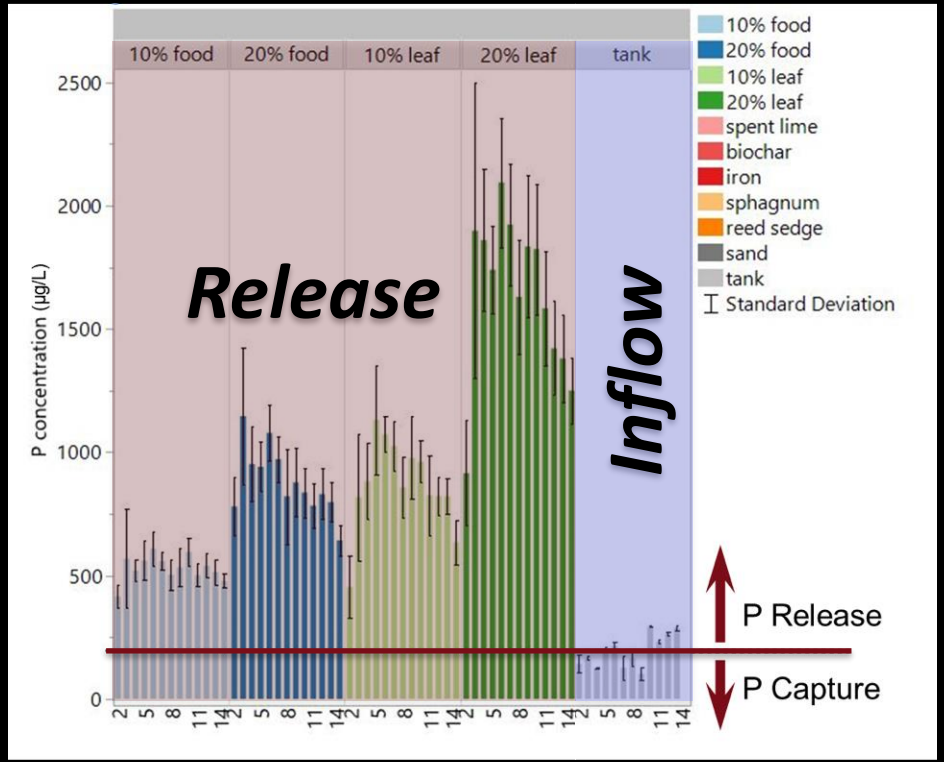
Jess Kozarek, UMN SAFL
Mike Isensee, Carnelian-Marine-St. Croix Watershed District
Mike Trojan, MPCA

Compost Benefits

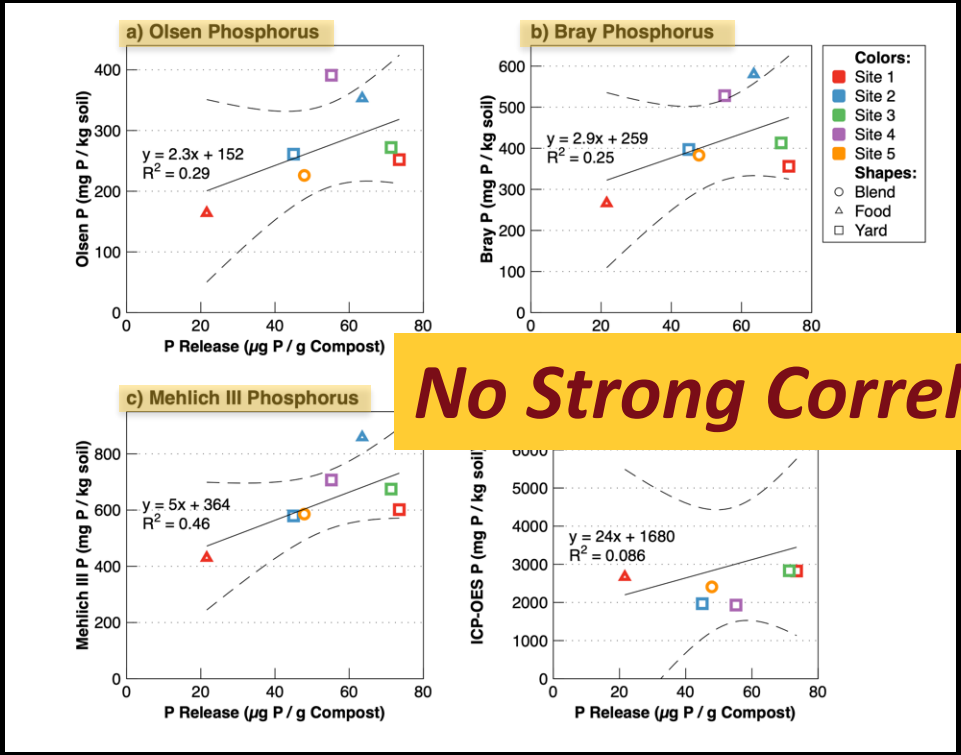
- Organic Matter Supports:
  - Vegetation Growth
    - Aesthetics, Pollinators, Natives, Evapotranspiration
  - Microbial Communities
    - Breakdown of Nitrogen, PAHs, & Carbon-based compounds
  - Moisture Holding
  - Metals Capture
  - Re-used Material / Sustainable Supply

Photo Courtesy: https://oaklandnursery.com/blog/?p=161

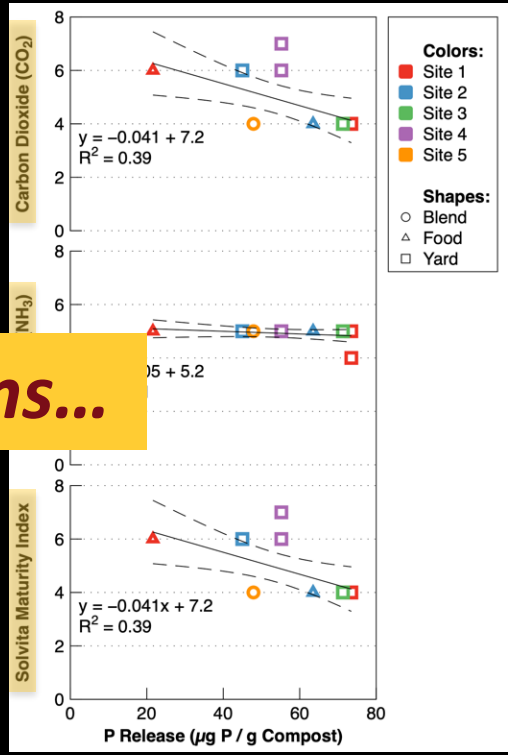
Phosphate Release is a Challenge!



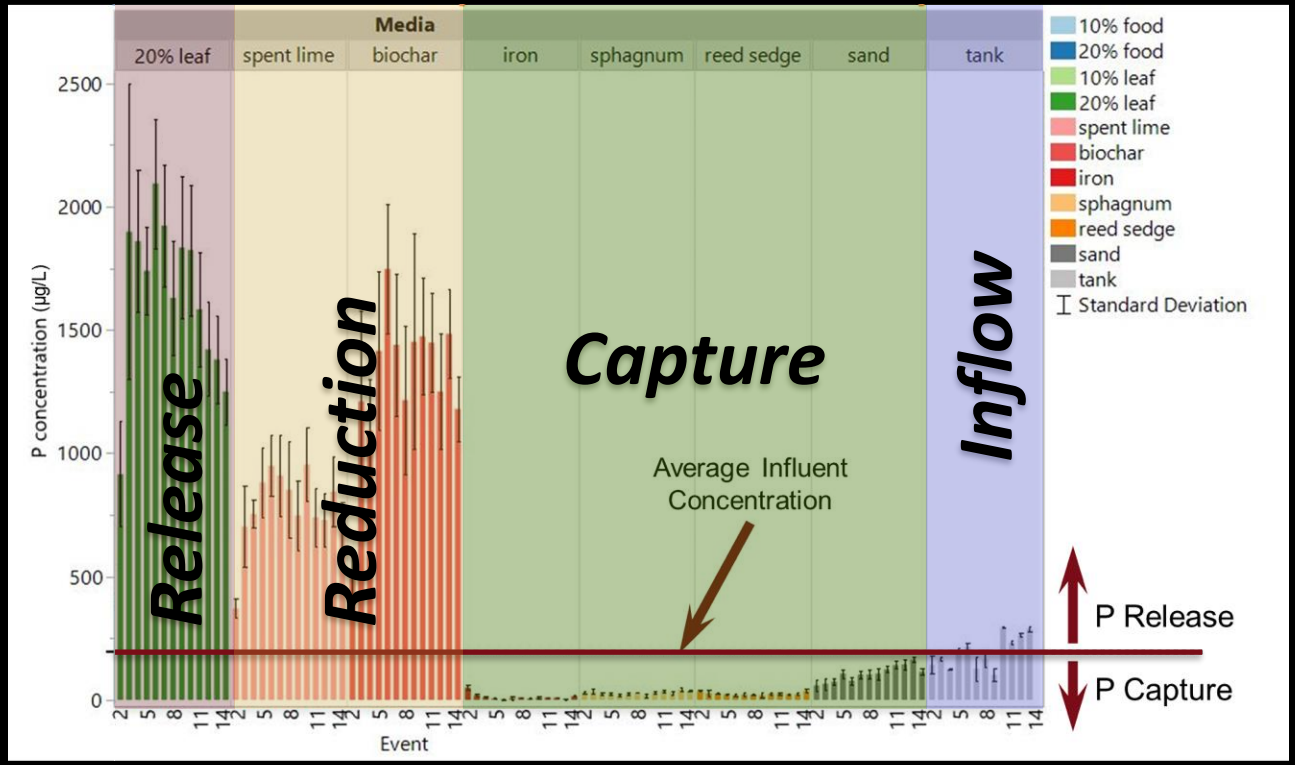
Is Phosphate Release Predictable?



No Strong Correlations…



What can we do?



Key Takeaways

- Compost has many positive benefits

- The primary consequence is Phosphate release;
  - Varies substantially by source material, site, time of year, etc.
  - Can be overcome with amendments, but we lose vegetation growth

Full Report: *Erickson, Andrew J.; Kozarek, Jessica L.; Kramarczuk, Kathryn A.; Lewis, Laura. (2021). Biofiltration Media Optimization – Phase I Final Report. Retrieved from the University of Minnesota Digital Conservancy, https://hdl.handle.net/11299/218193*

Stormwater UPDATES Newsletter

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UPDATES

NEXT WEEK!!
Minnesota Stormwater Seminar Series
May 20, 2021: Permeable Pavement Maintenance: Designing to Reduce Maintenance, Planning for Maintenance Frequency, and Effective Techniques to Restore Pavement Hydraulics

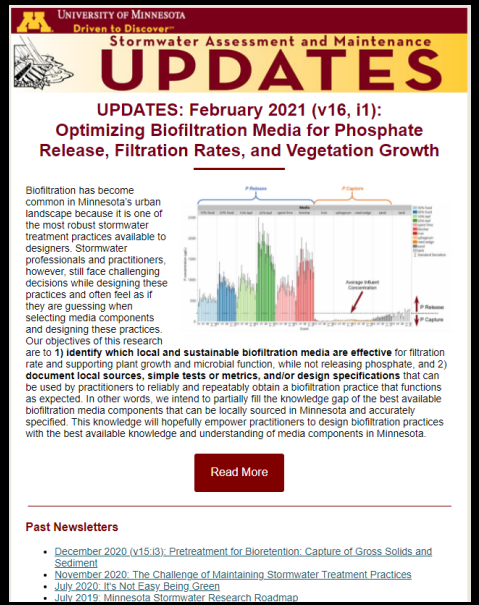
Please join us NEXT WEEK! on May 20, 2021 for the next Minnesota Stormwater Seminar Series event - *a bi-monthly experience featuring nationally recognized experts and researchers in stormwater and green infrastructure.*

Title: Permeable Pavement Maintenance: Designing to Reduce Maintenance, Planning for Maintenance Frequency, and Effective Techniques to Restore Pavement Hydraulics

Presented by: **Ryan Winston**, PhD, PE., Assistant Professor in the Department of Food, Agricultural, Biological Engineering, the Department of Civil, Environmental, Geodetic Engineering, and Core Faculty for the Sustainability Institute at Ohio State University

Panelists:
- **Craig Eldred**, Public Services Director, City of Waconia.
- **Paige Ahlberg**, Watershed Project Manager, Ramsey Washington Metro Watershed District.
- **Allison Bell**, Green Infrastructure Coordinator, City of Minneapolis.

Abstract:
Permeable pavement is an alternative to traditional asphalt or concrete and provides runoff reduction and water quality improvements provided it is properly maintained. The biggest challenge with this stormwater control measure is that it clogs over time. There is uncertainty around how to plan for maintenance, its associated costs, and what techniques to use to ensure long-term hydraulic function of these systems. This presentation will bring together nearly 10 years of field collected data on permeable pavement maintenance to determine: (1) how the engineering design of permeable pavements affects the rate at which they clog, (2) if a



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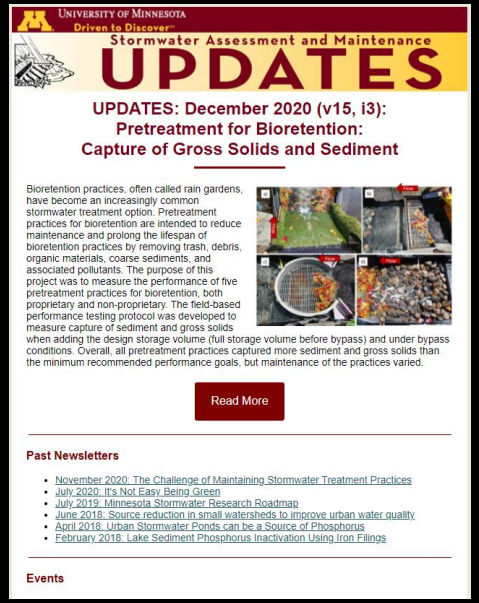
UPDATES: February 2021 (v16, i1):
Optimizing Biofiltration Media for Phosphate Release, Filtration Rates, and Vegetation Growth

Biofiltration has become common in Minnesota's urban landscape because it is one of the most robust stormwater treatment practices available to designers. Stormwater professionals and practitioners, however, still face challenging decisions while designing these practices and often feel as if they are guessing when selecting media components and designing these practices. Our objectives of this research are to **1) identify which local and sustainable biofiltration media are effective** for filtration rate and supporting plant growth and microbial function, while not releasing phosphate, and 2) **document local sources, simple tests or metrics, and/or design specifications** that can be used by practitioners to reliably and repeatably obtain a biofiltration practice that functions as expected. In other words, we intend to partially fill the knowledge gap of the best available biofiltration media components that can be locally sourced in Minnesota and accurately specified. This knowledge will hopefully empower practitioners to design biofiltration practices with the best available knowledge and understanding of media components in Minnesota.

Read More

Past Newsletters

- December 2020 (v15:i3): Pretreatment for Bioretention: Capture of Gross Solids and Sediment
- November 2020: The Challenge of Maintaining Stormwater Treatment Practices
- July 2020: It's Not Easy Being Green
- July 2019: Minnesota Stormwater Research Roadmap



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UPDATES: December 2020 (v15, i3):
Pretreatment for Bioretention:
Capture of Gross Solids and Sediment

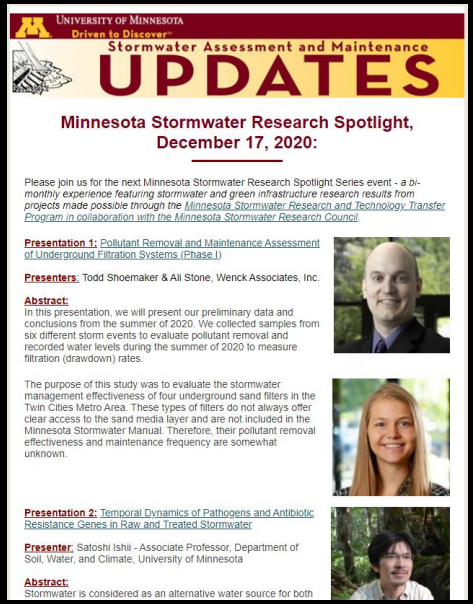
Bioretention practices, often called rain gardens, have become an increasingly common stormwater treatment option. Pretreatment practices for bioretention are intended to reduce maintenance and prolong the lifespan of bioretention practices by removing trash, debris, organic materials, coarse sediments, and associated pollutants. The purpose of this project was to measure the performance of five pretreatment practices for bioretention, both proprietary and non-proprietary. The field-based performance testing protocol was developed to measure capture of sediment and gross solids when adding the design storage volume (full storage volume before bypass) and under bypass conditions. Overall, all pretreatment practices captured more sediment and gross solids than the minimum recommended performance goals, but maintenance of the practices varied.

Read More

Past Newsletters

- November 2020: The Challenge of Maintaining Stormwater Treatment Practices
- July 2020: It's Not Easy Being Green
- July 2019: Minnesota Stormwater Research Roadmap
- June 2018: Source reduction in small watersheds to improve urban water quality
- April 2018: Urban Stormwater Ponds can be a Source of Phosphorus
- February 2018: Lake Sediment Phosphorus Inactivation Using Iron Filings

Events



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Minnesota Stormwater Research Spotlight, December 17, 2020:

Please join us for the next Minnesota Stormwater Research Spotlight Series event - *a bi-monthly experience featuring stormwater and green infrastructure research results from projects made possible through the Minnesota Stormwater Research and Technology Transfer Program in collaboration with the Minnesota Stormwater Research Council.*

Presentation 1: Pollutant Removal and Maintenance Assessment of Underground Filtration Systems (Phase I)

Presenters: Todd Shoemaker & Ali Stone, Wenck Associates, Inc.

Abstract:
In this presentation, we will present our preliminary data and conclusions from the summer of 2020. We collected samples from six different storm events to evaluate pollutant removal and recorded water levels during the summer of 2020 to measure filtration (drawdown) rates.

The purpose of this study was to evaluate the stormwater management effectiveness of four underground sand filters in the Twin Cities Metro Area. These types of filters do not always offer clear access to the sand media layer and are not included in the Minnesota Stormwater Manual. Therefore, their pollutant removal effectiveness and maintenance frequency are somewhat unknown.

Presentation 2: Temporal Dynamics of Pathogens and Antibiotic Resistance Genes in Raw and Treated Stormwater

Presenter: Satoshi Ishii - Associate Professor, Department of Soil, Water, and Climate, University of Minnesota

Abstract:
Stormwater is considered as an alternative water source for both

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Minnesota Stormwater Seminar Series

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Jon Hathaway


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Stephanie Hurley


Jane Clary


Rob Traver


Tom Scheuler & David Wood


Michelle Simon


Nina Bassuk


Ryan Winston

…and more to come!

Thanks for your attention!

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